PREMIER
AVIATION, INC.

OPERATION

AND

MAINTENANCE

INSTRUCTIONS

FOR THE

PREMIER AVIATION, INC.

400 AMPERE AUXILIARY GENERATOR SYSTEM

USED IN THE

BELL HELICOPTER 212/412 MODELS

DOCUMENT NUMBER B04-72002

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ORIGINAL

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ORIGINAL

SECTION I

INTRODUCTION

1-1. IDENTIFICATION

This manual provides operation and maintenance instructions for the Premier Aviation 400 ampere Auxiliary Electrical System for use on the BHT 212/412 series helicopter.

1-2. PURPOSE AND SPECIFICATIONS

This system is used as an engine-driven source of DC power designed to provide a separate source of 28VDC power.

Refer to Table I for equipment specifications.

TABLE I - SPECIFICATIONS

==========

GENERATOR (PART NUMBER: 400SG126Q-1)

D.C. Output

Volts	30.0
Amperes	400

Speed Range

Range (RPM)	6,800 - 12,000
Continuous Operating Range (RPM)	12,000
Min. Speed for Regulation (RPM)	7,200
Overspeed (RPM)	14,000
Cooling (RPM)	Blast Cooled

Overall Dimensions

Diameter (Max. In.)..... 6.21

Length (Max. In.) with QAD..... 12.87

Weight (lbs.)..... 18

Spline Data

Teeth..... 16

Pitch..... 20/30

Pressure Angle..... 30 degrees

GENERATOR CONTROL UNIT (PART NUMBER: GCSG505-2)

GCU Type

Pulse width modulated field output with integral current limiting, over/under voltage protection, reverse current protection, and ground protection.

Overall Dimensions

Diameter (Max. In.)..... 3.39

Length (Max. In.)..... 4.45

Height (Max. In.)..... 4.00

Weight (lbs.)..... .5

SECTION II

DESCRIPTION

2-1. GENERAL

2-1-1. The Premier 400 Ampere Auxiliary Generator system is designed to provide 400 Amps of well regulated 28 VDC Auxiliary power for the BHT 212/412 series helicopters.

2-1-2. The system consists of a 30 VDC, 400 Amp generator, a generator control unit (G.C.U.), 2 each 600 ampere line contactor relays, a 400 ampere current shunt, a pedestal mounted generator control panel with ammeter and misc. items (i.e. circuit breakers, wiring, etc.)

2-2. DETAILED

2-2-1. **Refer to figure's 1 and 2.** The generator is driven from an auxiliary gearbox that attaches to the hydraulic pump pad on the front of the transmission. The hydraulic pump attaches thru a quill assembly to the auxiliary gearbox. The gearbox increases the speed of the transmission output to approximately 12,000 RPM (the speed necessary to obtain 30 VDC from the auxiliary generator). The generator mounts to the upper pad of the auxiliary gearbox thru a quick disconnect adapter. Since the gearbox receives it's lubrication from the transmission oil system, a magnetic chip detector is installed in the gearbox and is connected to the transmission chip detector annunciation system.

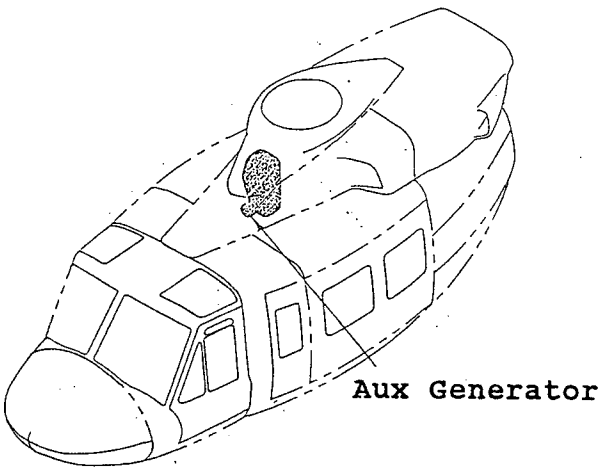


Figure 1

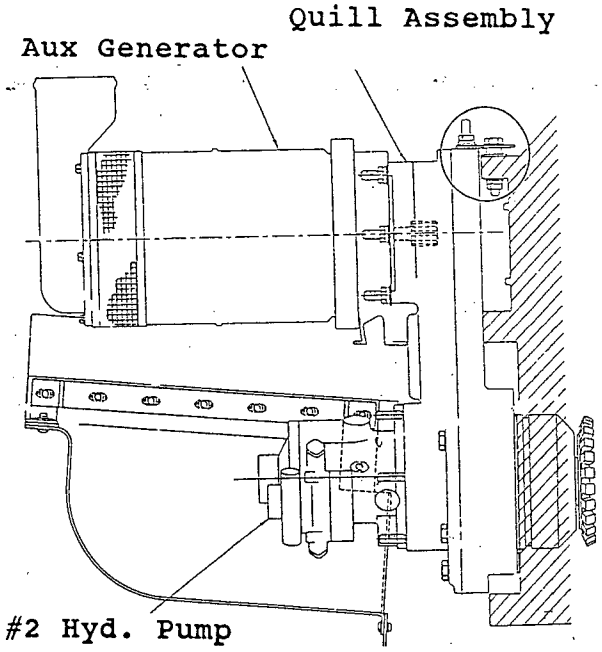


Figure 2

2-2-2. **Refer to figure 3.** The generator is forced air cooled by a 350 c.f.m. electric fan which is monitored to insure that no output is provided by the generator in the event of a cooling fan failure. This fan provides high speed outside air to the front of the generator where it is forced through the interior of the generator and exhausted out the rear. This insures that at maximum rated output, the bearings and brush assemblies operate within their rated temperature limits.

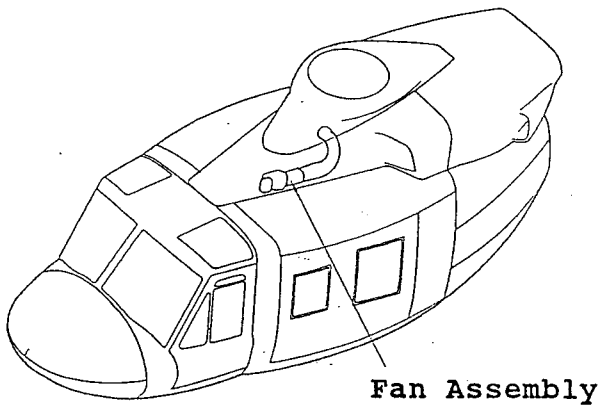


Figure 3

2-2-3. The generator is actually a starter/generator combination; however, the starter portion is not used in this application. All starter functions have been disabled.

2-2-4. The generator control unit provides voltage regulation, current limiting, over/under voltage protection, reverse current protection, ground fault protection, and output control. All interconnections are made thru one connector mounted on the front of the unit. Additionally there are two voltage test points and a potentiometer used to adjust the output voltage of the generator.

2-2-5. Load output is measured by a Mil. Spec. 400 ampere current shunt. The shunt is connected in series with the output of the generator. The amperage provided by the shunt is monitored by a digital ammeter in the pedestal generator control panel. This control panel also includes a switch to control the OFF/ON/RESET functions of the generator. The backlighting of this panel is controlled by the pedestal lighting dimmer.

2-2-6. With the exception of the reset voltage, the auxiliary generator system is completely self contained. Once operational, no power (except control panel backlighting) is required from the aircraft power systems.

SECTION III

OPERATION

NOTE
Refer to Figure's 3-1 and 3-2
for the following operational instructions.

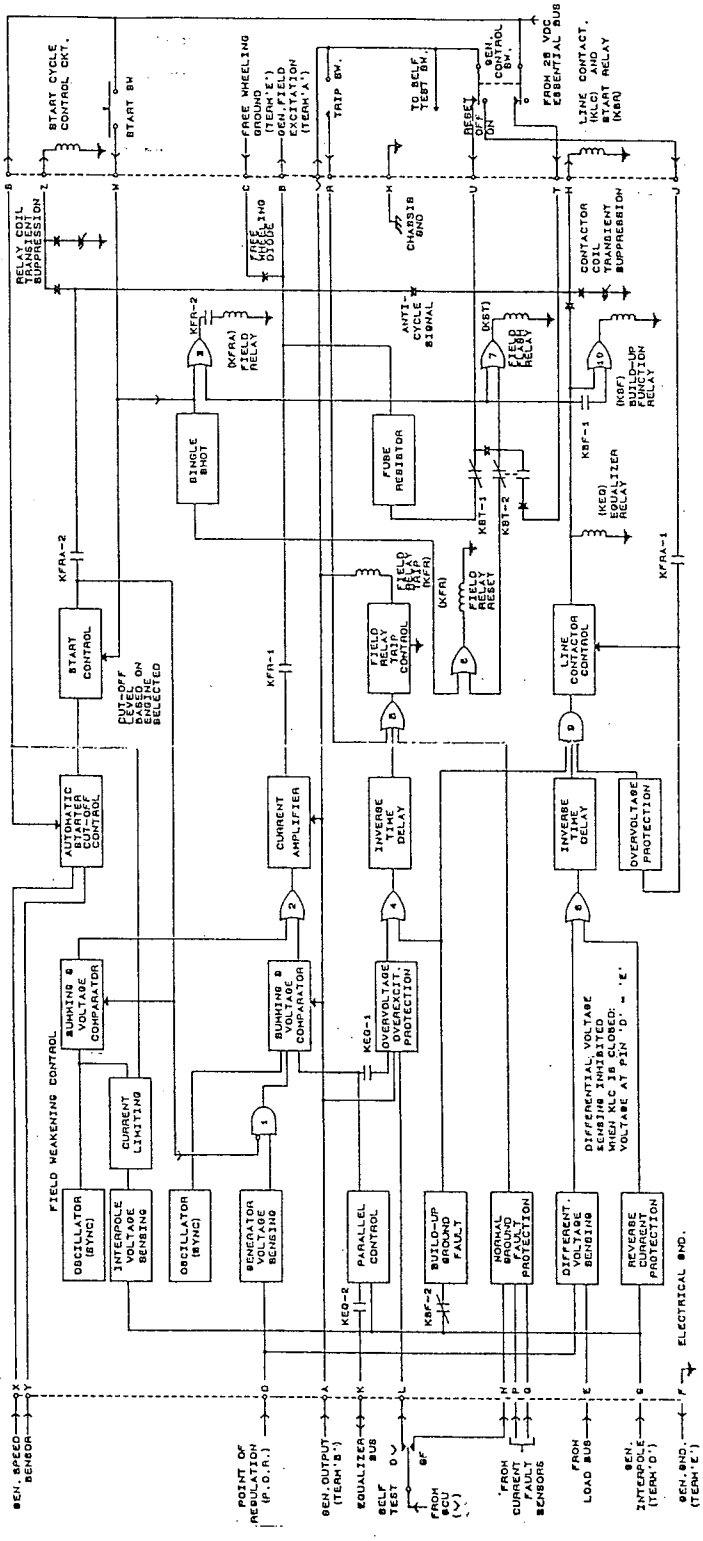
3-1. The output of the generator is self exciting. Residual magnetism in the generator stator windings will produce approximately 2-3 volts output, which when applied to the GCU will allow the generator to start producing voltage.

3-2. The GCU utilizes a pulse width modulator designed to maintain field voltage. The field output is a square wave signal of constant amplitude (approx. 12 VDC). The low impedance field windings in the generator act like a low pass filter to the pulse modulator of the GCU. The duty cycle of the pulses being output by the GCU determine the average voltage developed in the generator filed windings. As more or less current demand is put on the output of the generator, the GCU will increase or decrease the duty cycle of the pulses being output to the field.

3-3. When the voltage at the Point of Regulation input to the GCU reaches the desired regulation level, the field voltage being applied to the field winding of the generator will be reduced and maintained at a point that will regulate the output of the generator to the desired level. When the voltage at the Load Bus input differs from the Point of Regulation voltage, a voltage comparator inside the GCU will detect this difference and increase or decrease the frequency of the modulator which will vary the output. This causes the output of the generator to change until the two inputs reach equal voltage levels.

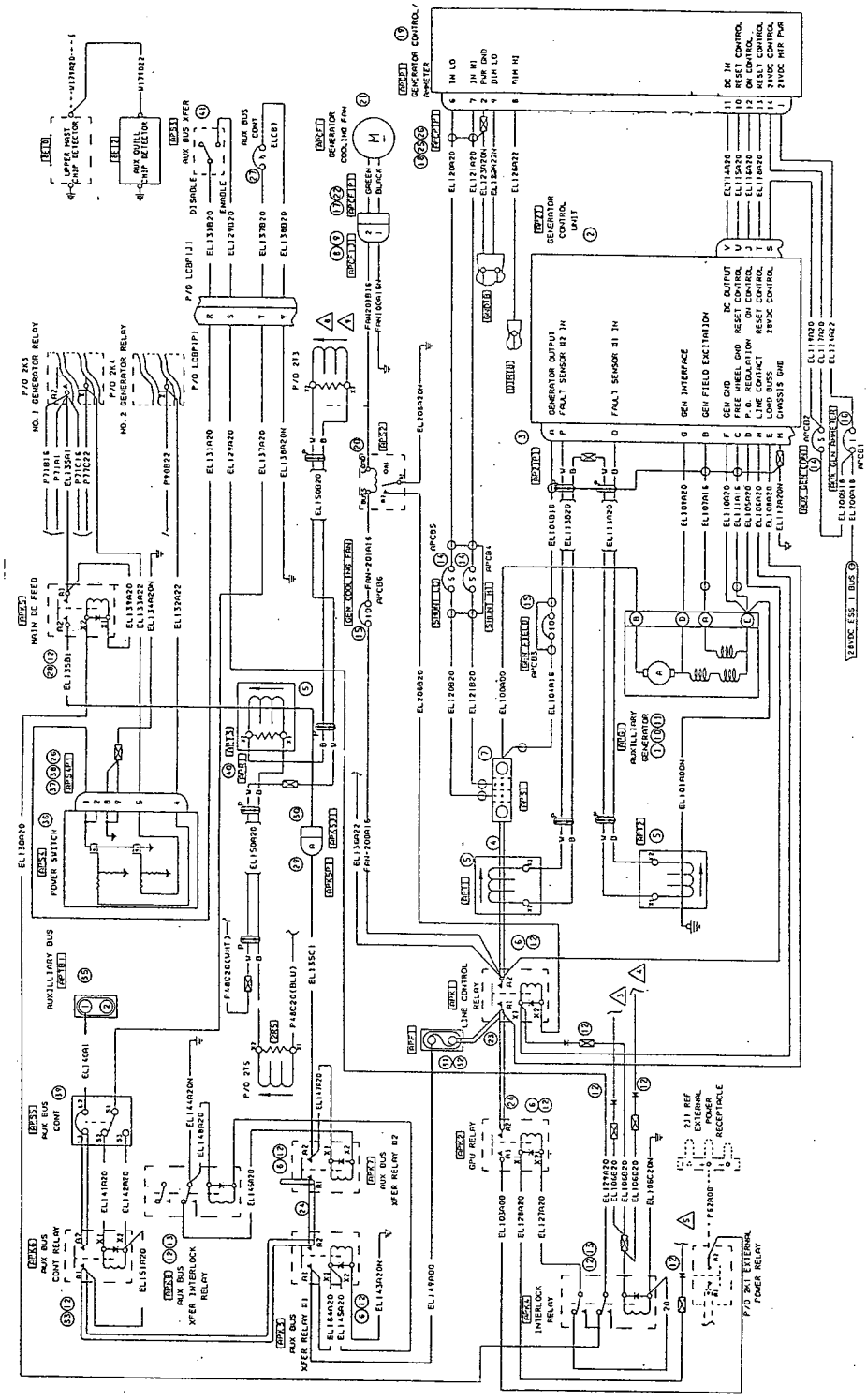
3-4. After the generator output is stabilized at the desired voltage and the error detect logic inside the GCU has detected no problems with the load of the generator, the OFF/ON/RESET switch (located on the Generator Control Panel) can be placed in the ON position. This will tell the GCU to engage the generator output line contactor. Regulated power is now being applied to the Load Bus of the system.

3-5. In the event of a detected problem, The GCU will de-energize the generator line contactor, which removes all load from the generator. At this time the OFF/ON/RESET switch on the pedestal generator control panel can be moved to the RESET position. This action will reset all error detection logic in the GCU and engage the generator line contactor when the switch is released.



BLOCK DIAGRAM, DC GCU

Figure 3-1.



FOR REFERENCE ONLY - PLEASE REFER TO YOUR AIRCRAFT DRAWINGS FOR YOUR PARTICULAR INSTALLATION FOR TROUBLESHOOTING.

Figure 3-2.

3-6. The ground fault detection circuit consists of two current sensing transformers. These transformers have the high current ground and output cables from the generator, physically passing through their cores. As current flows through these cables a voltage is induced into the transformers. If the output current and the ground return current are equal, the induced voltages will be balanced at the GCU input. If a current imbalance occurs this will be detected by the GCU and will cause a generator "trip". If the problem was transient, resetting the generator will restore generator power.

3-7. The interpole winding in the generator is used for over current and reverse current sensing. As the current demand from the generator increases, the interpole winding will produce a negative voltage proportional to the load on the generator. This is sensed at the Generator Interpole input. If this voltage exceeds the current limit of the generator (400 Amps.) the GCU will start reducing the output of the generator until the exceedance is removed or a "trip" occurs. If the voltage at Pin G should go positive this would indicate that a source other than the generator is providing power to the system. This is known as reverse current and would cause a generator "trip".

3-8. Extreme over or under voltage will be sensed internally within the GCU. Once on over or under voltage threshold has been reached the GCU will cause a generator "trip".

3-9. The output current shunt is effectively a low resistance, high power, precision resistor. The generator output is connected to one side of the shunt and the generator output line contactor is connected to the other. As current flows through the shunt the resistance of the shunt will cause a voltage drop across the shunt. Because this drop is very predictable it can be directly related to the current flowing through the shunt. The shunt in this system will produce 50 millivolts at 400 amperes of current. This voltage drop is measured and displayed on the ammeter in the pedestal generator control panel.

3-10. The external power portion of this system is provided to allow operation of the load bus while the aircraft is on the ground and the generator is not operating. When external power is applied to the aircraft this power is routed to the GPU relay (KAR-2). This relay is energized by the Auxiliary Power Unit sense pin on the APU plug at the front of the aircraft. This relay is automatically deenergized whenever external power is removed, the auxiliary generator is put on line, or either aircraft starter relay is engaged. The later is to protect the external power unit from excessive current demand during an engine start.

3-11. The pedestal generator control panel consists of the OFF/ON/RESET switch and the ammeter. The unit is backlit from the pedestal dimmer source. The ammeter inputs are protected by a 5 ampere circuit breaker on each leg and a 1 amp control circuit breaker.

3-12. The generator is forced cooled by a 350 C.F.M. turbofan which receives cool, outside air and distributes it into a special adapter mount at the front of the generator. Since this air is input at the front of the generator, it dissipates the heat generated by the front armature bearings and then passes through to the generator brush block and finally the rear armature bearings. This routing is necessary to insure adequite cooling of all internal generator parts. The 28 VDC which power this fan is routed through a current sensing relay. If the fan malfunctions, the relay will sense the loss of current flow and will disengage the generator output line contactor. Even though the generator is still outputing voltage, it can not be connected to a load.

3-13. There are six circuit breakers associated with this system. The breaker and their locations are as follows:

A. Generator Cooling Fan - Aft right hand compartment
B. Current Shunt Hi - Aft right hand compartment
C. Current Shunt Lo - Aft right hand compartment
D. Generator Field - Overhead breaker panel
E. Aux Generator Control - Overhead breaker panel
F. Aux Generator Ammeter - Overhead breaker panel

SECTION IV

OPERATING INSTRUCTIONS

4-1. Operation of the Auxiliary generator system consists of actuating the Off/On/Reset switch to the desired function. Once activated the only other required action is to monitor the ammeter to insure that no current requirement over 400 amperes is sustained.

NOTE

A momentary current draw of over 400 amps is not unusual upon initial turn on depending on environmental conditions. The current draw should drop within limits shortly after turn on.

SECTION V

SPECIAL MAINTENANCE TOOLS AND TEST EQUIPMENT

5-1. No special maintenance tools or test equipment are required.

SECTION VI

PERIODIC INSPECTION PROCEDURES

6-1. GENERAL INFORMATION.

6-1-1. Repeated brush inspections of the Auxiliary generator, can result in rapid brush wear and even cause brush hang-ups. When inspecting brushes, many operators will slide the brush cover off the back of the generator causing the brush leads to be misplaced. Sliding the cover forward again further misplaces the brush leads. Removing brushes from the brush boxes, will cause brush position in the box and relationship to the commutator to be disturbed. The mispostioned brush will wear faster than normal.

6-1-2. The following inspection procedure is designed to determine an average brush wear time frame for individual operating conditions and helps fix overhaul periods at the same time brushes must be replaced. One brush inspection between overhaul of the Auxiliary generator is all that may be required of some generator brushes. The 400 ampere Auxiliary Generator can usually operate for 800-1000 hours without brush changes. At that time, the generator can be removed for overhaul. Using this procedure will aid you in determining your overhaul times.

NOTE

This procedure can only be accomplished with a new generator or a generator that has been overhauled in accord with APC Overhaul Procedures and the commutator has been turned (resurfaced) in a lathe. Additionally, This procedure should be accomplished with each new or overhauled generator installed to determine the next overhaul time.

6-1-3. These procedures should be utilized each time the Auxiliary Generator is removed or installed to assist in improving the service life of the generator bearings, brushes, and drive shaft friction disk.

6-2. 300 HOUR INSPECTION PROCEDURE TO CALCULATE BRUSH LIFE ON THE AUXILIARY GENERATOR.

NOTE

Two mechanics are required to properly remove or install the Auxiliary Generator.

CAUTION

Slight misalignment and or binding of the Auxiliary Generator drive can reduce the unit's service life.

6-2-1. REMOVAL OF THE AUXILIARY GENERATOR.

1. Remove upper forward cowl (if not previously removed).

2. Disconnect all wiring from generator. Inspect wiring for general condition.

3. One mechanic is to maintain the alignment of the Auxiliary Generator by holding the generator in position by keeping the mounting surfaces flush with the quick attach/detach adapter (QAD pad), while the other mechanic loosens and removes the circular locking "V" band clamp.

4. Carefully remove the generator from the QAD pad by maintaining the spline's alignment to prevent binding of the generator drive.

5. Refer to Figure 6-1 and 6-2. Remove blast cover (6-1-40A). Visually inspect brushes. Locate shortest brush. Lift up brush spring (6-2-2) for shortest brush. Remove brush (6-2-3). Do not remove more than one brush, as brush seating will be affected.

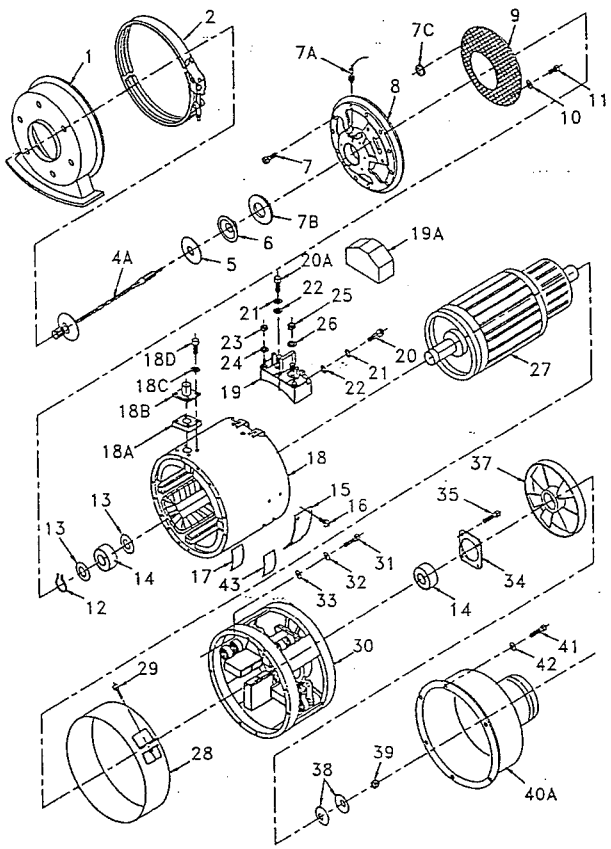


FIGURE 6-1

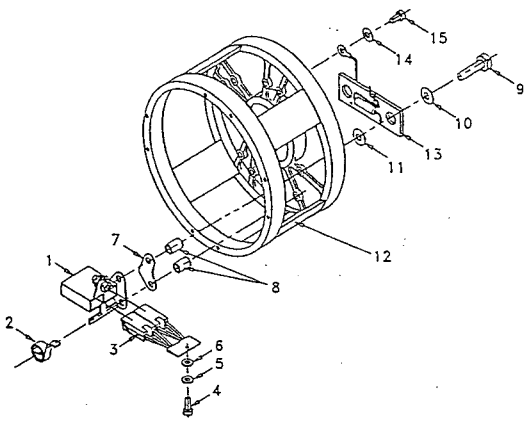


FIGURE 6-2

6. After conducting the brush inspection as called out on 6-13, reseat the brush back to it's original exact position. Reinstall spring and blast cover.

6-2-2.Calculate brush life as per following example:

Maximum wear length of a new brush: (1) .700

Brush wear left (as measured from shortest brush): (2) .375

TOTAL BRUSH WEAR: (3) .325

Hours brush has operated: (4) 300

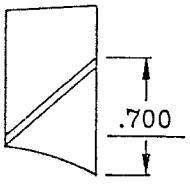
(3) .325 Total Brush Wear (from Item #2 Above) (4) 300 Hours Brush Operated (from) Item #4 Above) = (5) .00065 Rate of brush Wear Per hour

(2) .375 Brush Wear left (from Item #2 Above) (5) .00065 Rate of brush wear per hour (from Item #5 Above) = (6) 577 Hours of Brush wear left before brushes must be replaced

Generator Hours: 577 Hours left from Item #6 + 500 Total Hours on generator From Item #4 = 1077 Total Hours generator can operate TBO's

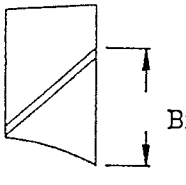
If 150 hours or more of brush life is left, reinstall the brush and operate the generator for the remaining hours of brush wear left, as calculated above. At that time, return the unit to an authorized APC Repair Station for overhaul.

New Brush



(1) Brush Length

Shortest Brush from Generator



Brush Wear Left (2)

Remove the generator the second time after the additional operating hours established by your calculations has been reached. Inspect the brushes. If all brushes are below the maximum brush wear mark, the generator mean time between overhauls has been established. If you desire, two or three generators can be tested to establish an average brush life.

6-2-3. Brush Calculation Sheet:

Aircraft Reg.:_____ **Generator S/N:**_____ **Date:**_____

Maximum wear length of a new brush: (1) _____

Brush wear left (as measured from shortest brush): (2) _____

TOTAL BRUSH WEAR: (3) _____

Hours brush has operated: (4) _____

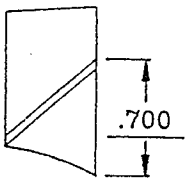
(3)_____ Total Brush Wear (from Item #2 Above) (4)_____ Hours Brush Operated (from) Item #4 Above) = (5)_____ Rate of brush Wear Per hour

(2)_____ Brush Wear left (from Item #2 Above) (5)_____ Rate of brush wear per hour (from Item #5 Above) = (6)_____ Hours of Brush wear left before brushes must be replaced

Generator Hours:_____ Hours left from Item #6 + _____ Total Hours on generator From Item #4 = _____ Total Hours generator can operate TBO's

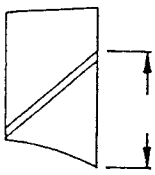
If 150 hours or more of brush life is left, reinstall the brush and operate the generator for the remaining hours of brush wear left, as calculated above. At that time, return the unit to an authorized APC Repair Station for overhaul.

New Brush



(1) Brush Length

Shortest Brush from Generator



Brush Wear Left (2)

Remove the generator the second time after the additional operating hours established by your calculations has been reached. Inspect the brushes. If all brushes are below the maximum brush wear mark, the generator mean time between overhauls has been established. If you desire, two or three generators can be tested to establish an average brush life.

6-2-3. INSTALLATION OF AUXILIARY GENERATOR.

1. Apply a anti-seize lubricant that meets MIL-A-907 specifications (recommend "FEL-PRO" Hi-Temp, CS-A, P/N 51007) to the spline of the generator.

2. One mechanic is to gently align the generator to the QAD pad, being careful not to put the generator drive spline in a bind.

3. After the generator has been properly aligned, one mechanic should hold the generator in position by keeping the mounting surfaces flush with the QAD pad while the other mechanic installs and secures the "V" band clamp.

4. Reconnect all generator wiring.

5. Preform a ground operational check of generator system.

SECTION VII

MAINTENANCE

7-1. GENERAL.

7-1-1. Maintenance of the Generator is limited to the replacement the Generator Brushes. All other maintenance should be conducted only by a Authorized APC Service Center.

7-1-2. Maintenance of the Generator Control Unit is limited to Regulator Voltage Adjustment and replacement of the entire unit, if unit is found to be defective.

7-1-3. Maintenance of the Auxiliary Gearbox (Quill) is to conducted by a Authorized Bell Service Center only and has a Time-Between-Overhaul of 5000 Hours.

7-1-4. Information regarding cost and availability of replaceable parts may be obtained from Premier Aviation at (214) 988-6181.

7-2. GENERATOR CONTROL UNIT REPLACEMENT.

7-2-1. Remove connector from unit. Remove four (4) screws from base of unit. Remove GCU. Install new GCU. Reinstall four (4) screws to base of unit. Reinstall connector to GCU and safety wire connector.

7-2-2. Operate system and just output of GCU, using the potentiometer on the front of the unit, for 28VDC at the two test points on the front of the GCU.

7-3. PEDESTAL CONTROL UNIT REPLACEMENT.

Loosen four (4) DZUS fasteners on panel. Lift panel from pedestal and disconnect connector from rear. Remove Panel. Reconnect connector to rear of new panel. Reinstall new panel in pedestal. Secure four (4) DZUS fasteners.

7-11.RELAYS KAR1/KAR2 REPLACEMENT.

Remove all wiring from relays (label wiring if necessary for installation). Remove Bus Bars from relays. Remove four (4) screws and associated hardware from base of relays. Remove relays. Install new relays. Reinstall four (4) screws with associated hardware to base of relays. Reinstall bus bars to relays. Reinstall all wiring to relays. Perform a ground check of the Aux. Generator system.

7-5.CURRENT SHUNT REPLACEMENT.

Remove all wiring from shunt (label wiring if necessary for installation). Remove two (2) bolts from base of shunt. Remove shunt. Install new shunt. Reinstall two (2) bolts in base of shunt. Reinstall all wiring to shunt. Perform operational check of system.

7-6.GENERATOR COOLING FAN REPLACEMENT.

Disconnect connector from fan wiring. Remove SCAT tubing from fan. Remove four (4) bolts and two (2) brackets which secure the fan to the roof. Remove fan. Install new fan. Reinstall four (4) bolts and two (2) brackets and secure fan to the roof. Reconnect SCAT tubing to fan. Reconnect fan wiring and perform an operational check of fan.

NOTE
Insure that only enough compression is placed on fan housing to secure the fan in place. Excessive compression will distort the case of the fan and could cause the fan blade to stall.

7-7.TRANSFORMER TRA-1 REPLACEMENT.

Remove wiring from transformer. Remove bus bar from center of transformer. Remove two (2) screws from base of transformer. Remove transformer. Install new transformer. Reinstall bus bar and wiring to transformer. Perform operational check of generator system.

7-8.TRANSFORMER TRA-2 REPLACEMENT.

Remove wiring from transformer. Remove wire EL101A00 from center of transformer. Remove two (2) screws from base of transformer. Remove transformer. Install new transformer. Reinstall wire EL101A00 and wiring to transformer. Perform operational check of generator system.